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ABSTRACT

This circular tells how and where to collect insects; how to kill, preserve, and display them; and what equipment is needed. In addition, descriptions and illustrations of all twenty-eight orders of insects are given. This booklet is written mainly for 4-H Club members and high school students but will be useful to anyone who wishes to collect and study insects. (BB)

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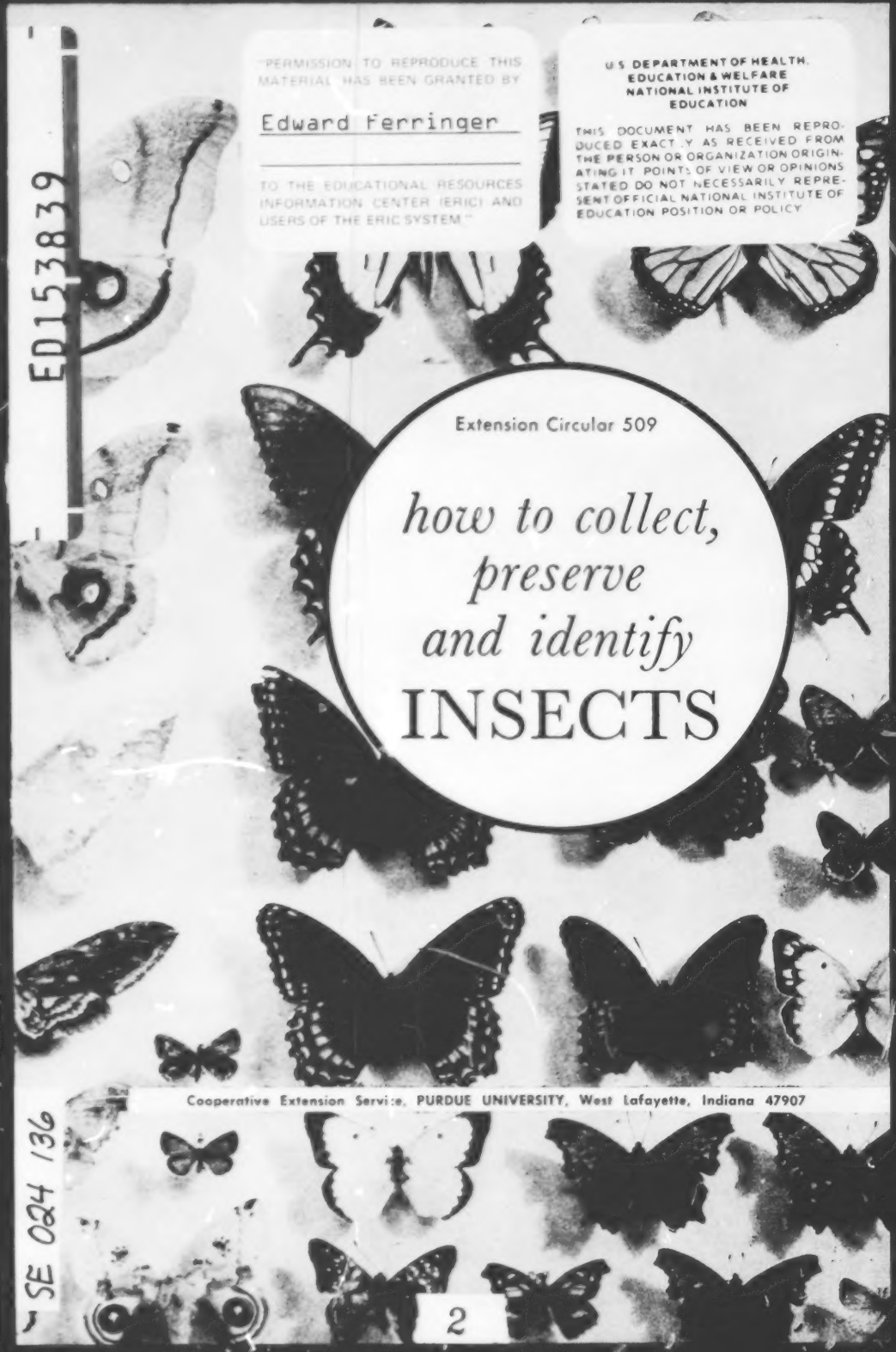

Extension Circular 509

how to collect, preserve and identify INSECTS

Cooperative Extension Service, PURDUE UNIVERSITY, West Lafayette, Indiana 47907

SE 024 136

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How to Collect, Preserve and Identify INSECTS

by D. P. Sanders and G. E. Lehker, former Purdue entomologists

Insects, in spite of their small size, are among the most interesting and fascinating creatures known to man. To the insect collector there is no end to the number of treasures in the fields, the woods, along the shores of lakes and streams and in many other places. In fact, insects are so universally present that we can find them any time of the year almost anywhere we care to search.

Collecting and studying insects provide hours of pleasure and satisfaction and creates an awareness of the place of insects in our environment. Adding a new specimen to a collection is an exciting experience. As new specimens are classified and placed in the collection, the student becomes increasingly aware of the similarity of insects belonging to the same group. He also becomes aware of the marvelous ways in which insects have adapted themselves to the conditions under which they live.

A knowledge of insects and their habits also help us to control insect borne diseases and prevent losses to crops, livestock and property by those species that are destructive.

The study of insects by 4-H Club members and high school students leads frequently to professional careers in entomology or related fields of biological science.

First and foremost in the minds of those beginning an insect collection should be proper labeling and preserving of specimens. There is always pride and satisfaction in a job well done, but even more important is the scientific value such a collection may have. Entomologists usually welcome the opportunity to study the insects of a well-preserved and labeled collection, because such collections supply distribution records and other information of value to the profession.

It is hoped this booklet will serve as a guide to those who, for the first time, wish to delve into the world of insects and collect and study the marvelous creatures that inhabit it.

INSECT COLLECTING EQUIPMENT

Large insect collections may be made using a small amount of inexpensive equipment. Nets and killing jars are the most essential, although a few other items mentioned later will come in handy and enable the collector to obtain a larger variety of specimens.

The Net

A net serves two purposes. One is to *beat* or *sweep* foilage. This means

Figure 1. The insect net.

that the net is swung back and forth so that it scrapes the tops of plants and collects insects that are feeding or resting there. The other use for the net is to collect bees, wasps, butterflies, dragonflies and other flying or wary insects. A suitable net is one that is sturdy enough to sweep plants, yet light and porous enough to be swung through the air. Such a net can either be purchased or made at home.

A net (Figure 1) consists of a handle fitted on a heavy wire loop. A bag is fastened to the loop.

Select a strong, lightweight handle about 3 feet long. A ¾ inch dowel rod is ideal for this purpose. Cut two grooves along the sides at one end as shown in Figure 2a. These grooves cradle the bent arms of the hoop and should be cut as deep at the thickness of the wire. Make one groove about 3½ inches long, and the other 2½ inches. At the end of each, drill a small hole through the handle.

To make the hoop, bend a 4-foot length of about ⅛-inch durable steel wire, preferably piano wire, into a hoop with short arms at each end as shown in Figure 2b. Take care that the arms and little hooks at their ends are bent just right to fit along the grooves and into the holes in the handle. After fitting the hoop to the handle and properly attaching the

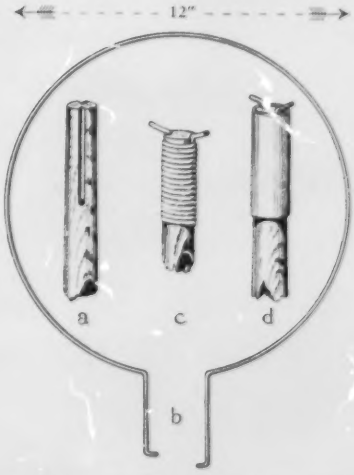

Figure 2. The net ring. Two grooves of unequal length are cut on opposite sides of handle at one end (a). These grooves terminate in small holes into which the bent arms of the wire hoop or ring (b) are fitted.
The joint may be wrapped with wire (c) or fitted with a sliding ferrule (d).

bag, you are ready to make the joint fast between the handle and the hoop.

Wrap the joint tightly with fine wire (Figure 2c) or better still fit the handle with a sliding metal ferrule (Figure 2d). A short piece of ¾ inch copper or aluminum tubing will fit snugly over a dowel rod of that diameter.

The bag should be cut out and made cone shaped as shown in Figure 1 and should be twice as long as the diameter of the hoop. This length lets you loop the bag over the rim and thus prevent the escape of insects. An ideal material for making the bag is nylon mosquito netting available from surplus stores. A good quality marquisette or similar material can also be used, but cotton mosquito netting or cheese cloth is not satisfactory.

To construct the net bag, cut out two pieces of net material the size and shape shown in Figure 3. Place these together, one directly atop the other and sew from point "a" to point "b" to point "c". This seam should be about ½ inch in from the cut edges. Fold the outer edge (from the seam to the cut edge) back onto the body of the net and sew around once more, this seam being about ⅛ inch from the cut edges. To make a loop for the wire hoop, use a strip of heavy muslin 5 x 44 inches. Fold it lengthwise to form a hem around the top of the bag. The top edge of the net should be placed between the two sides of the folded muslin. Tuck the cut edges of the muslin in such that the edge of the net and the tucked edges of the muslin overlap at least ½ inch. Combine these by twice sewing completely around near the middle of the overlap.

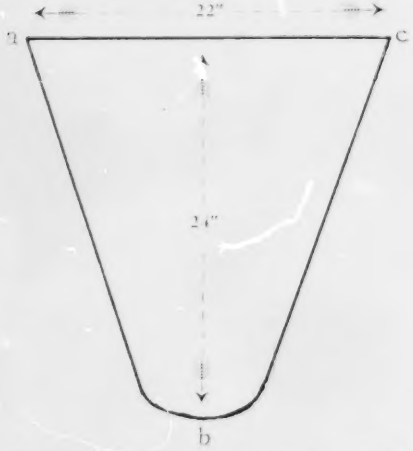

Figure 3. Pattern for net material.

The Killing Jars

After insects have been collected, they must be killed quickly without breaking or otherwise damaging them. A killing jar is used for this purpose. Every collector should have at least two such jars—one large enough for butterflies and moths and another for beetles and small insects.

Sodium or potassium cyanide jars are the most satisfactory types. These can be purchased from biological supply houses. It is becoming increasingly difficult for collectors themselves to make the jars because of restrictions governing the sale of these kinds of cyanide. The ready-made jars must also be shipped express, which adds considerably to the cost of individual jars. For this reason, orders for cyanide jars should be grouped and the jars purchased in quantity.

Other types of jars that use ethyl acetate or dichlorvos insecticide as the killing agent can be made at home. The ethyl acetate jar is safe and excellent for use by young people and beginning collectors. Instructions for making these jars, as well as the cyanide jar, are given below. Regardless of the type made, select a jar of heavy glass having a large mouth and a screw cap.

Ethyl acetate jars: Pour 1 inch of wet plaster of paris into the bottom of the jar; let it harden, and dry it thoroughly in the oven. Next, saturate the dry plaster of paris with ethyl acetate, and pour off any excess liquid that does not soak in. The jar is now ready to use. Keep it tightly capped. When the jar losses its strength, dry it again in the oven and recharge it. Ethyl acetate can be obtained from druggists.

Dichlorvos strip jars: A killing jar can be made by using cut pieces of the common "no-pest" strip that contains dichlorvos insecticide. These commercially available resin strips release an insecticide which is toxic to insects at low concentrations. The killing jar is made by cutting part of a strip into pieces about ½ inch square. These are placed in the bottom of a wide-mouth jar (use enough to cover the bottom of the jar) and covered with a thin or porous piece of cardboard. The cardboard edges should fit snugly against the inside of the jar. A few pin prick holes through the cardboard will help the fumes of the insecticide penetrate the cardboard. Frequent removal of the cap will allow the insecticide fumes to escape from the jar and cause it to lose its effectiveness. This type of jar will not kill insects as rapidly as the ethyl acetate or cyanide jars. When it no longer is effective, replace the old pieces of resin strip with newly cut ones.

Cyanide jars: First, cover the bottom of the jar with a thin layer of sodium or potassium cyanide. Next, cover the cyanide with a 1-inch layer of dry plaster of paris powder; then cover this with a layer of wet plaster of paris, and allow to harden.

Cyanide produces deadly poisonous fumes, and in a properly-made jar, the concentration of fumes is sufficient to kill most insects within a few minutes. Killing jars, as well as all other containers of cyanide, should be marked "poison" and kept away from small children and other persons not familiar with the dangerous properties of cyanide. Don't be afraid to use a cyanide jar, however, since the concentration of fumes outside the jar is not sufficient to produce harmful effects.

The bottom half of the completed jar should be wrapped with adhesive tape to prevent the cyanide from getting into a wound in case of accidental breakage. Cyanide jars eventually lose their strength. When this happens, they should be disposed of and others made.

How to Use Killing Jars

Always keep a piece of clean, crumpled paper in each jar to absorb moisture and keep the specimens from becoming rubbed or broken. A successful insect collector makes it a practice to mount and label all speci-

mens within a few hours after they are caught. Insects left in the killing jar for a day or two will become soft and ruined, whereas those taken out but not pinned will become too brittle to handle.

Never put damaged or mutilated specimens in the killing jar. Most insects are so plentiful that there is no excuse for wasting time and energy trying to mount and label anything less than a perfect specimen.

Other Collecting Equipment

A supply of small tin boxes will come in handy, especially on long collecting trips. They will serve as temporary storages so that large numbers of specimens can be collected without crowding the killing jars.

Butterflies, moths, dragonflies, and other large-winged insects are best protected after they have died by removing them from the jars and carefully placing each specimen in an individual envelope or in a rectangular paper folded to form a three-cornered envelope. The wings should be folded above the back to prevent the scales from being rubbed from the tops of the wings.

Larval stages of insects and other soft-bodied specimens should be preserved immediately in a fluid, such as 80 percent alcohol or a 4 percent formaldehyde solution. Many collectors carry with them a few small vials of preservative fluid to store these specimens.

A better method, especially in the case of caterpillars, grubs and maggots, is to carry them home in empty vials or tin boxes, submerge them for 1 to 2 minutes in boiling water, then place them in the vials of preservative fluid. This process kills bacteria in the digestive tract and prevents discoloration. After a day or two, the liquid may become discolored. When this happens, transfer the specimens permanently to a new solution.

It is also a good idea to carry a pair of forceps, 4 to 5 inches long, to handle butterflies, moths, and other delicate insects. Very small insects are best handled by means of a small brush.

Last but not least, the collector should always carry a pencil and notebook for jotting down important facts about the specimens collected. Many collectors prefer to carry their field equipment, such as killing bottles, vials, forceps, and brushes, in an army-type knapsack.

Other equipment for special purposes will be mentioned in connection with the discussion on how to collect insects.

WHERE TO COLLECT INSECTS

Although many insects are easily found, certain kinds live in obscure and unusual places. Knowing where to look for them will add greatly to the pleasure and productiveness of an insect-collecting trip.

In summer, insects are the most plentiful on the flowers and foliage of growing plants, in and around pools and streams, beneath decaying logs or the bark of dead trees, around bright lights in the evening, along

the borders of woods and on the ground among grasses and weeds. Some insects come out only at night, while others are found only on or near the plants upon which they feed.

In winter, most insects seek shelter and are found in clumps of grass, beneath the loose bark of trees, under stones and logs or beneath leaves and soil debris. Many burrow into the ground to pass the winter. Although insects are more difficult to find during the winter, searching for them is none the less interesting.

The bodies of dead animals often produce many specimens, usually scavenger beetles, which are not likely to be found elsewhere. The same is true of the droppings of livestock, where still other kinds of insects are apt to be found. With a little experience the collector will soon learn where to look for the less common specimens.

HOW TO COLLECT INSECTS

Many insects may be picked up and dropped into the killing jar. Those that inflict injury, such as the bees and wasps, are comparatively few, and the collector will soon learn of them by experience. Even so, they may be scooped up with the net or caught by placing the jar over them as they rest on flowers and foliage.

By far the largest number of insects can be collected by sweeping weeds, grass or any other foliage with the collecting net. The net is swung back and forth, scraping the foliage as the collector walks along. As soon as you stop sweeping, grasp the bag with the left hand to prevent escape of the specimens. They may then be picked out by hand, with forceps or a small brush and dropped in the killing jar. Many flying insects can be collected with the net, especially during the summer. Few insects can resist the odor of nectar, and many bees, wasps, and butterflies can be collected with the net as they rest on flowers. Dragonflies and damselflies are found near water.

Warm, cloudy, sultry nights in the summer offer the best conditions to collect moths, beetles and other insects attracted to lights. You will find that different species are continually appearing during the same season, so lights afford good collecting all during the summer. Many aquatic insects are attracted to lights near lakes and streams. Lights may also be put up especially to attract insects.

In the same manner that some insects are attracted to light, others are attracted to sweetened baits. Decaying meats also attract many beetles, which may be trapped if the bait is placed in a glass jar sunk in the soil so the opening is flush with the ground surface.

Collecting aquatic insects is real sport. Many insects may be found by turning over logs and stones in the bottom of shallow ponds and streams, while for other kinds it is necessary to have a specially con-

structed dip net. Such a net is really a heavy screen scoop-shovel affair, which may be swept through the water at different levels or scraped through the mud and debris at the bottom.

Careful attention is needed to collect insects from leaf mold and soil debris, since some of the specimens are very small and may be easily overlooked. Some collectors place the trash on a sheet of white oilcloth or paper and collect the insects as they attempt to crawl away. Specially constructed separators may also be made or purchased, in which the debris is placed until all the insects have crawled from it and trapped themselves in an attached jar.

Small trees and shrubs may be jarred or shaken and the insects collected as they fall into an inverted umbrella or a canvas spread under the tree. This method is used to good advantage in collecting insects that play "possum" when disturbed.

Every collector will find many needs for a good pocket knife, which can be used to remove borers from stumps, etc. A trowel will come in handy to dig in the ground for larvae, pupae and adult insects that may be found there.

How to Handle Butterflies and Moths

Butterflies and moths often thrash around in the net or killing jar and rub the scales from their wings, thus spoiling the specimens. This can be prevented by pressing the sides of the thorax vigorously with the thumb and forefinger to paralyze the insects. With a little experience it is easy to paralyze specimens through the cloth of the collecting net so they can be lifted out without danger of damage or escape.

HOW TO PRESERVE INSECTS

After collecting insects, the next step is to preserve them permanently for future use and study. Insect larvae and other soft-bodied specimens should be preserved in liquids already described, but all others may be preserved on insect pins designed for that purpose. Large insects are mounted directly on the pins, while those too small to be placed on pins are mounted on card points.

The wings of butterflies, moths, dragonflies, and occasionally other insects are spread to make the specimens more attractive and to aid in identification. After insects have been properly pinned and labeled, they are kept in display boxes having a soft flooring into which the pins can be inserted.

The Relaxing Chamber

If insects have become too hard and brittle to pin, they can be made soft and pliable again by placing them in a relaxing chamber for 1 or 2 days. To make a relaxing chamber, find a large jar or container as airtight as possible. In the bottom, place an inch or two of clean sand saturated with water and a few drops

of carbolic acid to prevent mold. Place the specimens to be relaxed in shallow, open containers upon the sand, and fit the lid tightly on the relaxing chamber. Take them out and mount them as soon as they are soft enough to handle easily. They would be ruined if left in the relaxing jar too long.

Remember that the relaxing chamber should not be used as a general practice. It is always best to pin specimens within a few hours after they are collected.

HOW TO PIN INSECTS

Insects pins may be obtained from any dealer in entomological supplies. Do not use common pins, since they will rust and soon ruin what may be valuable specimen. Pins come in several sizes, but No. 2's and No. 3's will be found the most useful.

Any insect that is large enough to support a pin without breaking or otherwise being distorted may be pinned directly through the body. Insert the pin through a definite part of the body from top to bottom (Figure 4a). The place of insertion de-

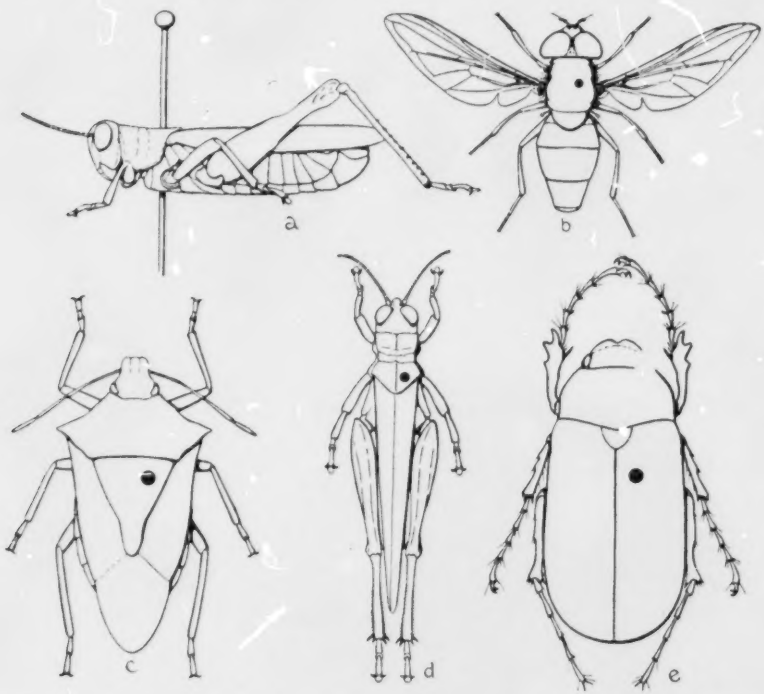

Figure 4. Side view (a) of a pinned grasshopper. The black dots show the location of the pins in the (b) fly, (c) stink bug, (d) grasshopper and (e) beetle. The pins are inserted through the insects from top to bottom, leaving ¼ to ⅓ the length of the pins projecting above the backs.

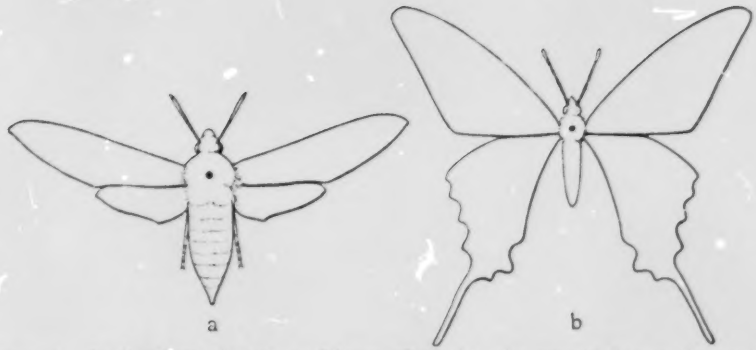

Figure 5. In both moths (a) and butterflies (b), the pin is thrust through the center of the thorax between the bases of the fore wings, just to the right of the mid-line.

pends upon the type of insect. The following rules have been set up for pinning different types of insects so that the pin may be placed firmly through the heavier parts of the body without destroying important identifying characteristics.

1. Bees, wasps, flies, etc.: Pin through the thorax between bases of fore wings and just to right of middle line (Figure 4b).

2. True bugs: Pin through the scutellum, which is the triangular area between the bases of the wings (Figure 4c).

3. Grasshoppers, crickets, etc.: Pin through the prothorax or "saddle" just to the right of the center line (Figure 4d).

4. Beetles: Pin through the fore part of the right wing cover near the center line (Figure 4e).

5. Butterflies, moths, dragonflies, etc.: Pin through center of thorax between the bases of fore wings (Figure 5a and 5b).

About ¼ to ⅓ of the pin should project above the insect to facilitate handling the specimen.

As each specimen is pinned, straighten the legs, antenna or wings so they will dry in the desired position. Soft-bodied insects, such as crickets or walking sticks, can be held in position by blocking them up with pieces of light cardboard placed on the pin. These temporary supports should not be removed until the specimen has become thoroughly dry.

The Pinning Block

The appearance of a collection is vastly improved if all the specimens are placed at a uniform height on the pins. This is easily done by using a "pinning block" (Figure 6). Such a block may be made either of wood or metal. Metal blocks, of course, must be purchased, but wooden ones can be made at home.

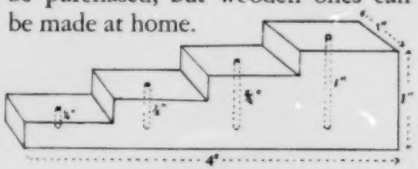

Figure 6. The pinning block. This device is used to adjust both insects and labels to their proper heights on the pins.

The wooden block is cut out of a soft piece of wood 1 inch square and 4 inches long, or it may be built up by gluing together four pieces of ¼-inch finishing lath. Small holes are drilled through each of the four steps, which are ¼, ½, ¾ and 1 inch high, respectively. After an insect is placed on a pin, either the head or the point of the pin is inserted in the desired hole and the specimen adjusted to the proper height. The block is also very useful to adjust labels to a uniform height upon the pins.

How to Pin Small Insects

Figure 7 illustrates the card point method used to mount very small insects. Cut all points to a uniform size, ⅜ to ½ inch long and about ⅛ inch wide at the base. They are easily cut from a strip of filing card paper as wide as the points are to be long. Cut a large supply at one time, and keep them in a box for future use. This will save time and assure that the points will be uniform in size.

Note from Figure 7 that the pin is pushed through the base of the triangle and the specimen glued to the point. It is very important that the point be to the left of the pin and the specimen glued so that it will face away from the operator.

Mounting insects on card points is not difficult if you know the correct procedure. First, put the card point on the pin, and place a small amount of glue on the tip. Next, lay the specimer on its back on the edge of a table in such a maner that the pin and point can be turned upside down and pressed lightly against the insect. With a little practice you will learn to lay the specimen so that it will be in the correct position when glued to the point.

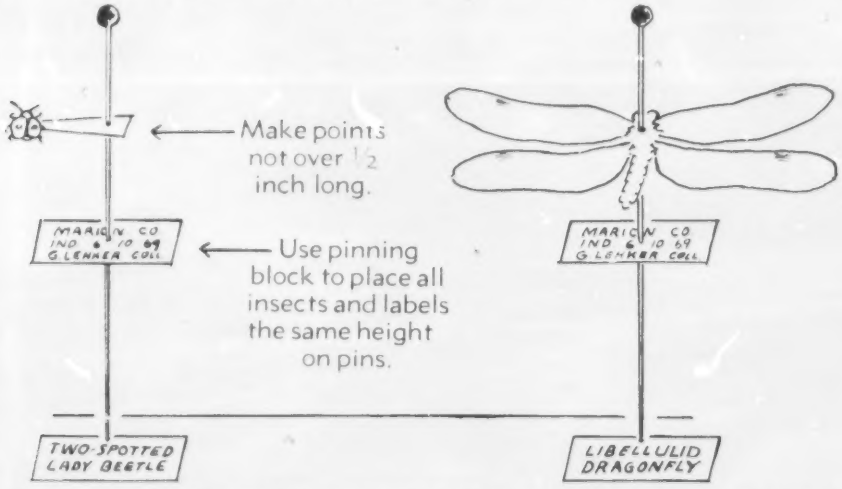
Make points not over ½ inch long.
Use pinning block to place all insects and labels the same height on pins.
MARION CO IND. 6 10 69 G LEHMAN COLL
MARION CO IND. 6 10 69 G LEHMAN COLL
TWO-SPOTTED LADY BEETLE
LIBELLULID DRAGONFLY

Figure 7. Mounting small insects and labeling. Insects too small to be pinned may be mounted by the card point method (left). All others should be mounted directly upon the pins (right). Note the position of labels on the pins.

THE SPREADING BOARD

Butterflies, moths and frequently other insects are mounted with their wings spread. A spreading board is used for this purpose and is an important piece of equipment for the insect collector. Eventually, the collector should have different-sized spreading boards to accommodate both large and small insects, but one board will do for the beginner. Adjustable spreading boards are available from entomological supply houses.

The complete spreading board (Figure 8) may be made at home, if desired, and is made of the following materials:

1. Two end blocks, 5½ inches long and 1 inch square.

2. Two soft wood top pieces, 16 inches long, 2½ inches wide and about ½ inch thick. These pieces should be planed down so that they are ⅜ inch thick on one edge.

3. One flat strip of corrugated box paper or cork, 14 inches long, 1 inch wide and about ½ inch thick.

The two top pieces are nailed to the end blocks (Figure 8), leaving about ½ inch between the thin edges. The cork or corrugated paper is then tacked beneath the top pieces to cover the opening and provide

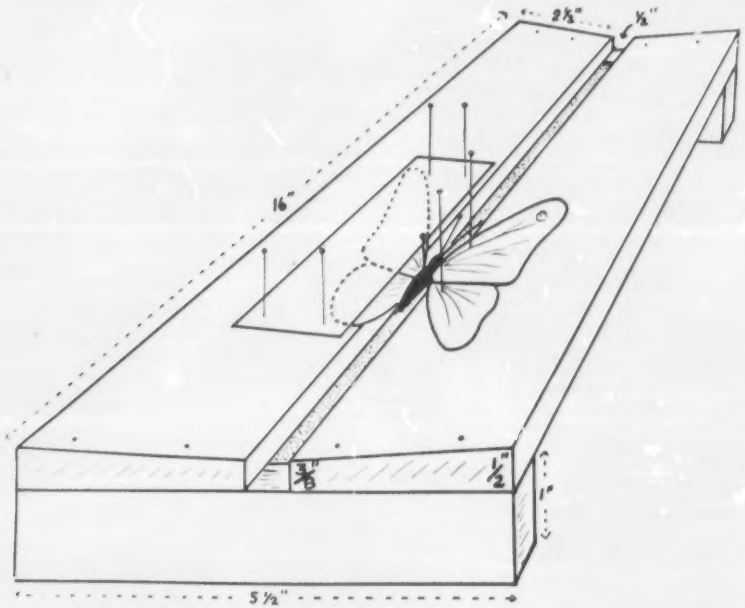

Figure 8. The spreading board showing dimensions. A pin is inserted through the body into the cork so the specimen rests in the groove. The wings are then pulled forward and held temporarily by pins, as shown on the right, while they are being permanently secured by a strip of paper shown on the left.

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soft material into which insect pins can be inserted.

The slope of the top pieces permits the wings to dry in a slight upward position. This allows for any sag that may occur after the specimen is removed from the board. Spreading boards with flat top pieces will do, but insects must remain upon such boards for a longer time.

The top pieces can also be sloped by carving the top sides of the end blocks into shallow "V's."

An inexpensive spreading board can be made from styrofoam. A grove to accommodate the body of the insect can be carved into a block of this material or pieces of styrafoam can be glued together to make a board similar in size and shape to the wooden one previously described. Boards of this kind do have some disadvantages. For example, they are more likely to rub the scales from the wings as they are being spread.

Spreading the Wings

Before attempting to spread an insect's wings, make sure that the insect is fresh or thoroughly relaxed. Pin the specimen in the usual manner; then thrust the pin through the cork, and push down until the body lies in such a way that the wings are flush with the top pieces. Now, with a fine pin or needle caught behind the heavy front margin of each wing, pull the fore wings forward until their hind margins form a straight line at right angles to the long axis of the body. Then hold the fore wings in place temporarily by pushing the pins into the wood, and work the hind wings forward in a similar manner until their front margins are concealed beneath the fore wings. After you are satisfied with the position of the wings, secure them permanently by pinning strips of paper lengthwise across them.

Most collectors notch these strips of holding paper so the strips will fit around the temporary pins and cover the entire wing surface. After the wings are secured, remove the temporary pins, and set the board aside for 10 days or 2 weeks, after which the specimens may be removed.

HOW TO LABEL SPECIMENS

To be of any scientific value, every specimen must be accompanied by information including the date and locality of its capture, and the name or initials of the collector. These data are printed on a small label that is placed on the pin beneath the specimen as shown in Figure 7. Collections for scientific purposes also have a second label on each pin showing the host or habitat of the specimen. This is not required in the 4-H Club project.

The size of these pin labels in 4-H collections should be not over 7/8 inch long and 5/16 inch wide. This is about the smallest size upon which 4-H members and high school biology pupils can write or print with ease. Labels used by entomologists, biologists and college students are usually much smaller.

Homemade labels should be cut from stiff paper, such as filing card stock. It is essential that all labels be the same size; and collectors will find many advantages in cutting a large supply for future use. Those directing the activities of insect-collecting groups might want a printer to set up the locality labels in small type so that only the date and initials of the collector need be filled in by hand.

Always use a pinning block to place labels at a uniform height on the pins.

DISPLAY BOXES

Pinned insects cannot be kept in good condition unless placed in boxes to protect them from dust and damage. A standard display box is 18 inches x 24 inches x 2¾ inches outside measurements and has a glass top. Figure 9 shows a box that is simple and easy to make.

Precaution Against Pests

Several types of small dermestid beetles as well as other incidental pests readily feed upon dry insect specimens. To protect against these pests, keep the inside of all display boxes dusted lightly with a 5% chlordane dust. Naphthalene is also a good repellent. If collections are infested, paradichlorobenzene flakes (PDB) can be used as a fumigant. Simply scatter a liberal amount of the flakes on the floor of each box, and close the lid.

Flat pieces of celotex or styrafoam provide a handy place for the temporary holding of pinned specimens while they are being labeled, identified or arranged in display boxes.

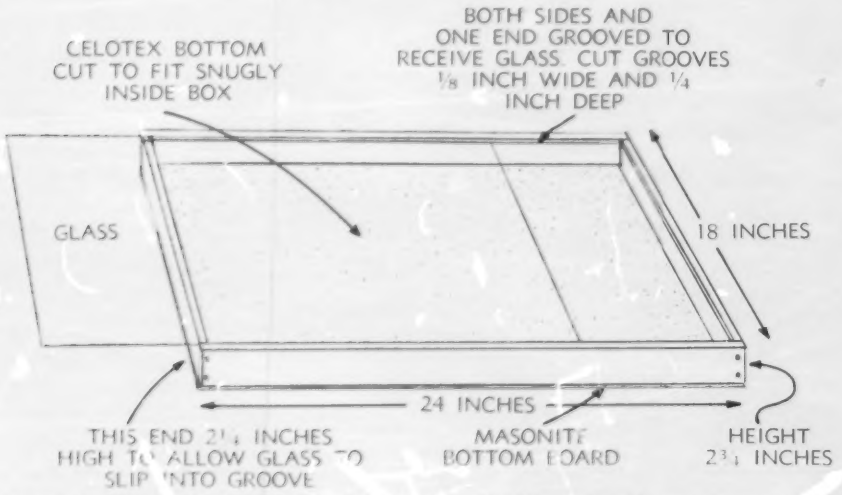

CELOTEX BOTTOM CUT TO FIT SNUGLY INSIDE BOX
BOTH SIDES AND ONE END GROOVED TO RECEIVE GLASS. CUT GROOVES ⅛ INCH WIDE AND ¼ INCH DEEP
GLASS
18 INCHES
24 INCHES
THIS END 2¼ INCHES HIGH TO ALLOW GLASS TO SLIP INTO GROOVE
MASONITE BOTTOM BOARD
HEIGHT 2¾ INCHES

Figure 9. An inexpensive display box for holding pinned insect specimens.

HOW TO ARRANGE INSECTS IN BOXES

Insects are always displayed in boxes under appropriate *order* labels. These labels can be printed by hand, ordered from supply houses or obtained from the Department of Entomology, Entomology Hall, Purdue University, West Lafayette, IN 47907. The labels should be about 2 inches long and 5/16 inch wide. They are pinned directly to the floor of the box, and all specimens representing that order are arranged in neat rows in a rectangular area below the label. Always arrange the insects so they are viewed from the side and *not* by standing the box on end. *Family* labels, if used, should be smaller or of a different color, and also pinned to the floor. Additional labels showing common or scientific names are placed on the floor of the box and held in place by the pin on which the specimen is mounted (Figure 7).

HOW TO REAR INSECTS

As the collector becomes more familiar with the activities and habitats of insects, he will soon begin to find them in many of their life stages. It is natural to wonder when a strange caterpillar is found just what it will be when its life cycle is complete. We wonder what is the source of an ugly brown pupa, an odd-appearing larva seined from the bottom of a pond, or even a mass of tiny insect eggs.

To rear insects and observe them as they pass through their stages of development is fascinating and beneficial too, because it enables the collector to associate the insects in their life stages, thus adding to the pleasure of collecting and studying them.

Most insects are easy to rear if an environment is provided similar to that in which they were found. Many kinds of rearing cages can be used, most of which are constructed of screen to prevent escape of the adults as they emerge. If you want to rear a caterpillar and have found it feeding on oak leaves, place it in your cage and give it oak leaves to eat. Unless you are familiar with the habits of the insect being reared, it is best to provide a few inches of soil in the bottom of the rearing cage, since many insects must have soil in which to transform.

Rear aquatic insects by placing them in an aquarium with the proper environment. They must receive the kind of food they naturally feed on. In the case of water insects, this is usually tiny aquatic plants or insects.

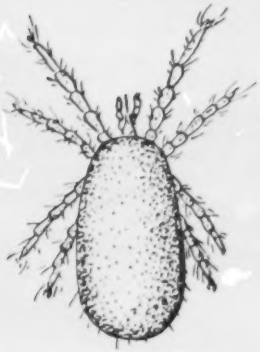
Many of the predaceous insects such as antlions and praying mantids, may be kept in glass cages and fed ants, flies and other live insects.

CLOSE RELATIVES OF INSECTS

Insects and their relatives make up the group or phylum of animals called the Arthropoda, which is characterized by having segmented bodies and appendages (legs and antennae). The phylum Arthropoda is divided into a number of classes, five of which are considered here. These five are: Hexapoda (insects), Crustacea (crayfish, sowbugs or pillbugs, and fairy shrimps), Arachnida (spiders, daddy longlegs, ticks, mites, and scorpions), Diplopoda (millipedes or thousand leggers), and Chilopoda (centipedes or hundred leggers).

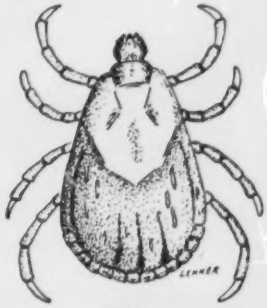
These classes of Arthropoda may be distinguished from each other by the following characteristics:

The Hexapoda have six legs and usually two pairs of wings, being the only Arthropoda that possess wings. The Crustacea have 10 to 14 legs. The Arachnida have eight legs. The Diplopoda have long bodies composed of about 50 segments, each of which has two pairs of legs. The Chilopoda have long bodies composed of 14 to 20 segments, each of which has one pair of legs.



Mite
Class Arachnida

Spider
Class Arachnida



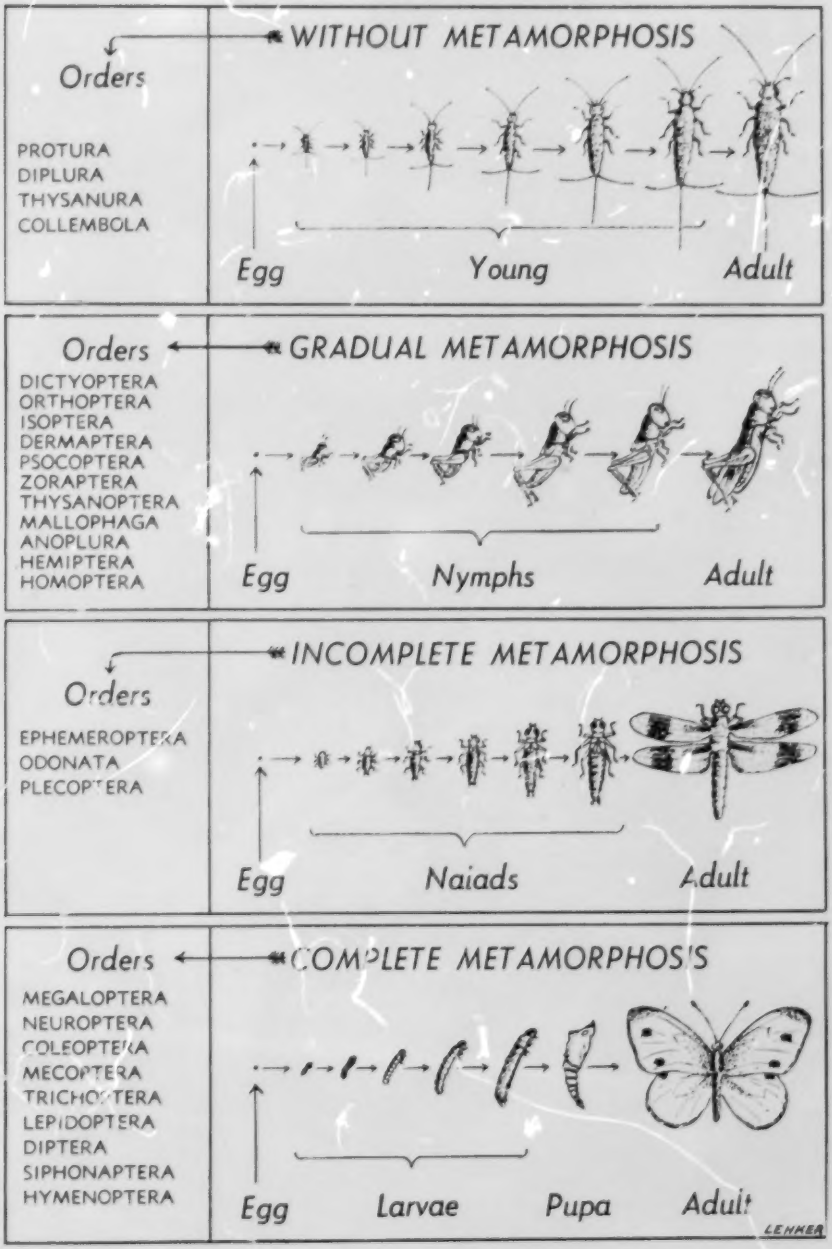
Tick
Class Arachnida

Centipede
Class Chilopoda

Sowbug
Class Crustacea

Millipede
Class Diplopoda

THE DEVELOPMENT OF INSECTS



Note: Insects said to be without metamorphosis are so classified for convenience. They do undergo some metamorphosis, although not readily discernible.

THE ORDERS OF INSECTS

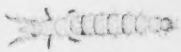
Beginning collectors will soon learn that authorities do not always agree upon the number of orders into which insects are divided. In this publication, the authors follow the system that recognizes 28 orders, 27 of which occur in Indiana. The order Embioptera does not occur in Indiana. Two orders, Protura and Zoraptera, are extremely rare and seldom encountered, even by the most experienced collectors. The person who can find one or more representatives of the remaining 25 orders will learn a great deal about insects and their habits.

Protura—The proturans

One species known to occur in Indiana.

The proturans are minute, whitish, wingless insects, 1/50 to 3/50 inch long. They differ from all other insects by having no antennae and 12 abdominal segments. The mouthparts are minute, needle-like and of the piercing-sucking type. Proturans develop without metamorphosis, the life stages being the egg, young, and adult.

These insects are so small they are overlooked by most collectors. They probably occur throughout Indiana, but have been found in only a few counties. Proturans live in moist soil, in decaying leaves and logs, and beneath loose bark.



Proturan
Family Acerentomidae

Diplura—The diplurans (campodeids and japygids)

About 7 species occur in Indiana.

The diplurans are small, slender, wingless, blind insects. They have long, many-segmented antennae and a pair of either segmented or forceps-like appendages at the tip of the abdomen. Diplurans develop without metamorphosis. They are usually found under leaves, logs, stones or other debris, usually in contact with the soil where it is damp.

Dipluran
Family
Campodeidae

Dipluran
Family
Japygidae

eff 19 20

Thysanura—The bristletails

About 7 species occur in Indiana.

The bristletails are fast running, wingless, fish-shaped insects, up to ½ inch long. They have long antennae and two or three long, antennae-like appendages at the end of the abdomen. Bristletails have chewing mouthparts and develop without metamorphosis; that is, the young or growing stages closely resemble the adults, except they are smaller. The life stages are egg, young and adult.

Most bristletails live out-of-doors under stones and other objects on the ground. However, the two most common species—the silverfish and the firebrat—live in houses where they feed on rayons, starched clothing, book bindings and other materials containing starch or glue.

Bristletail
Family Lepismatidae

Collembola—The springtails

About 125 species occur in Indiana.

The Collembola are very small, wingless, leaping insects up to 1/5 inch long, with short antennae. They have chewing mouthparts and develop without metamorphosis, the life stages being egg, young and adult. Collembola are able to flip themselves into the air by means of a spring-like organ on the underside of the abdomen.

Most species live out-of-doors on decaying vegetation and are found under stones, in decaying leaves and in other damp places. Some are commonly found clustered on the sides of trees where sap is oozing out, still others collect in large numbers on still water.

Springtail
Family Entomobryidae

Springtail
Family Sminthuridae

Dictyoptera—The cockroaches, praying mantids and walkingsticks

About 20 species occur in Indiana.

The Dictyoptera are medium to large-sized insects with chewing mouthparts. Included are wingless, short-winged and long-winged forms. The winged forms have two pairs; the front pair leathery, the hind pair membranous, larger and folded up like a fan under the front wings. Walkingsticks and some cockroaches are wingless. Metamorphosis is gradual. Walkingsticks live out-of-doors and feed on plants. Praying mantids are beneficial in that they feed on other insects. Cockroaches may be found either in or out-of-doors but most commonly are indoor pests.

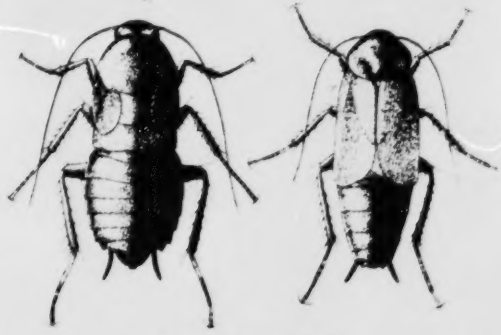
Wood cockroach
Family Blattidae

German cockroach
Family Blattidae

Walkingstick
Family Phasmidae

Praying mantid
Family Mantidae

American cockroach
Family Blattidae



Oriental cockroach
(female, left; male, right)
Family Blattidae

Orthoptera—The grasshoppers, meadow grasshoppers, katydids and crickets

About 150 species occur in Indiana.

The Orthoptera are medium to large-sized insects with chewing mouthparts and usually four wings, the front pair being narrow and leathery. The hind wings are large and fold up like a fan under the front wings. Camel crickets are wingless. Metamorphosis is gradual, the life stages being the egg, nymph, and adult.

Most members of this order, including grasshoppers, katydids, and tree crickets, live out-of-doors and feed on plants. Crickets may be found either in or out-of-doors.

Camel cricket
Family Gryllacrididae

Cricket
Family Gryllidae

Tree cricket
Family Gryllidae

Mole cricket
Family Gryllotalpidae

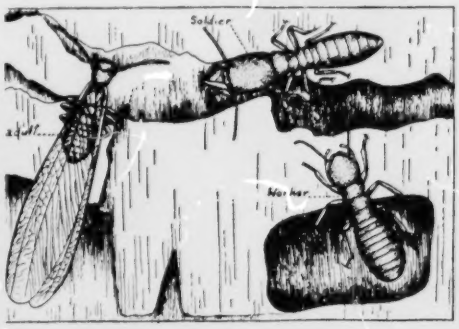
Grasshopper
Family Acrididae

Katydid
Family Tettigoniidae

Isoptera—The termites

Five species occur in Indiana.

The termites are medium-sized, social insects. Their colonies contain three castes—workers, soldiers, and swarmers (sexually mature kings and queens). The workers and soldiers are wingless and dirty-white in color. The swarmers are dark-bodied and have four long, many-veined, whitish wings. They have chewing mouthparts and a gradual metamorphosis, the life stages being the egg, nymph, and adult.



Termite
Family Rhinotermitidae

Termites are sometimes incorrectly called white ants, but they are very different from ants in both structure and metamorphosis. True ants, which belong to the order Hymenoptera, have the abdomen constricted (pinched in) just back of the thorax; termites do not.

Termites may be found in logs, stumps, fence posts, timbers of buildings, or in wood lying on the ground.

Dermaptera—The earwigs

About 5 species occur in Indiana.

The earwigs are small to medium-sized insects usually having four wings. The front pair are like those of beetles but are very short, leaving most of the abdomen exposed. The hind wings fold under the front wings. Earwigs are equipped with a pair of forcep-like organs on the end of the abdomen, which distinguishes them from the Coleoptera, especially the rove beetles, which also have short wing covers. Earwigs have chewing mouthparts and a gradual metamorphosis, the life stages being the egg, nymph, and adult.

These insects are rarely seen. They live out-of-doors and, for the most part, hide during the daytime under leaves and in cracks in the ground. They come out at night and are sometimes attracted to lights.

Earwig
Family Forficulidae

Psocoptera (Corrodentia)—The booklice and psocids

About 30 species occur in Indiana.

The Psocoptera are tiny insects that have either four wings or none at all. They have chewing mouthparts and a gradual metamorphosis, the life stages being the egg, nymph, and adult.

Some of the wingless Psocoptera are called booklice and are found around old books, papers, and in damp, dark rooms. Other wingless species live out-of-doors. Those with wings are called psocids (pronounced so-sids). They live out-of-doors and are found resting on stones, logs, and fences.

Booklouse
Family Liposcelidae

Zoraptera—The zorapterans

One species known to occur in Indiana.

The zorapterans are minute insects, 1/50 to 3/25 inch long with either four wings or none. They are pale colored and resemble termites in appearance. They have chewing mouthparts, and their metamorphosis is gradual, the life stages being the egg, nymph, and adult.

Zorapteran
Family Zorotypidae

Zorapterans have been collected rarely in Indiana, but they probably occur throughout the southern half of the state. They live in colonies in sawdust piles, beneath the bark of fallen trees and in rotten logs. The colonies often are found near termite galleries.

Thysanoptera—The thrips

About 75 species occur in Indiana.

The thrips are tiny insects, with or without wings, and are rarely over 1/8 inch long. They have rasping-sucking mouthparts, which they use to rasp the surface of leaves and suck up the juice as it oozes out. Metamorphosis is gradual, the life stages being the egg, nymph, and adult.

Thrips are commonly found on many plants, including gladiolus, onions and greenhouse crops. A common species that annoys people lives on small grains and grasses and is called the "oats bug."

Thrips
Family Thripidae

Mallophaga—The chewing lice

About 70 species occur in Indiana.

The chewing lice are wingless, flat-bodied insects, parasitic on birds and, to some extent, mammals (warm-blooded animals that have hair). They have chewing mouthparts and feed on bits of hair, feathers, scales and dried blood. They develop with gradual metamorphosis, the life stages being the egg, nymph, and adult. All adults are wingless.

Chewing lice attack all kinds of wild and domesticated birds as well as many of the common mammals. The eggs are glued to the feathers or hair of the host.

Chewing louse
Family Menoponidae

Anoplura—The sucking lice

About 15 species occur in Indiana.

The sucking lice are wingless, flat-bodied insects that look much like the chewing lice. The head, however, is narrower than the thorax, and the mouthparts are fitted for piercing the skin and sucking blood. They develop with gradual metamorphosis, the life stages being the egg, nymph, and adult. All adults are wingless. Sucking lice are parasitic on mammals but never attack birds.

Hog louse
Family Haematopinidae

Hemiptera—The true bugs

About 850 species occur in Indiana.

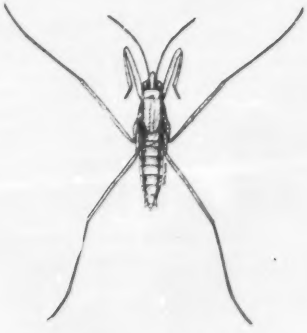
The true bugs usually have four wings, the front pair being thick at the base and thin at the tips. These wings are folded flat on the back so that the tips overlap each other. A few species, such as the bed bug, are wingless. All true bugs have piercing-sucking mouthparts, which form a noticeable beak. Metamorphosis is gradual, the life stages being the egg, nymph, and adult. Many of the true bugs possess stink glands and give off an unpleasant odor.

Most of the true bugs live on land, but many, such as the giant water bug and water striders, live in or on water. Usually, those that live on land feed on plant juices, but a few, including the bed bug, are parasites of man and other animals. Some even prey on other insects.

Water boatman
Family Corixidae

Backswimmer
Family Notonectidae

Giant water bug
Family Belostomatidae



Water strider
Family Gerridae

(Hemiptera illustrations continued)

Bed bug
Family Cimicidae

Plant bug
Family Miridae

Garden fleahopper
Family Miridae

Assassin bug
Family Reduviidae

Lace bug
Family Tingidae

Chinch bug
Family Lygaeidae

Squash bug
Family Coreidae

Leaf-footed bug
Family Coreidae

Negro bug
Family Corimelaenidae

Stink bug
Family Pentatomidae

Harlequin cabbage bug
Family Pentatomidae

Homoptera—The cicadas, leafhoppers, treehoppers, scale insects, aphids, spittlebugs, planthoppers and mealybugs

About 1,100 species occur in Indiana.

Members of the order Homoptera vary widely in appearance. They range from small to large and may or may not have wings. If wings are present, they are usually four in number and are held roof-like over the body. The front wings may be transparent as in the case of cicadas, or colored as in the case of leafhoppers. All Homoptera have piercing-sucking mouthparts and a gradual metamorphosis, the life stages being the egg, nymph, and adult.

The winged forms include leafhoppers, cicadas (sometimes called locusts), spittlebugs, planthoppers and treehoppers. The plantlice or aphids, include both winged and wingless forms. Scale insects are covered throughout most of their lives by a waxy scale. All Homoptera feed on plants. Many serious pests belong to this order.

Cicada
Family Cicadidae

Buffalo treehopper
Family Membracidae

Treehopper
Family Membracidae

Spittlebug
Family Cercopidae

Leafhopper
Family Cicadellidae

Planthopper
Family Dictyopharidae

Planthopper
Family Acanaloniidae

Aphid
Family Aphididae

Mealybug
Family Pseudococcidae

Armored scale
Family Diaspididae

Ephemeroptera (Ephemerida)—The mayflies

About 60 species occur in Indiana.

The mayflies have four triangular many-veined wings, the front pair being much larger than the hind pair. They have chewing mouthparts, but the adults do not feed. The antennae are short and difficult to see. Mayflies have two or three long, antenna-like appendages at the end of the abdomen. Metamorphosis is incomplete, the life stages being the egg, naiad, and adults.

The naiads or young mayflies live in water. The adults are commonly found near streams, ponds and lakes and are attracted to light. The adults live but a few hours or days, but the naiads take from 1 to 3 years to develop.

Mayfly
Family Ephemeridae

Odonata—The dragonflies and damselflies

About 145 species occur in Indiana.

The Odonata are large insects having four long, many-veined wings of about equal size. They have chewing mouthparts and very short antennae. The metamorphosis is incomplete, the life stages being the egg, naiad, and adult.

Dragonflies are larger than damselflies and hold their wings horizontally, like an airplane, when at rest. Damselflies either uptilt their wings like butterflies or fold them next to the abdomen when at rest.

The naiads of Odonata are found in water and the adults near water. Both the adults and naiads feed on other insects. Sometimes the naiads feed on small fish.

Dragonfly
Family Libellulidae

Damselfly
Family Coenagrionidae

Plecoptera—The stoneflies

About 57 species occur in Indiana.

The stoneflies are from ½ to 2 inches long and have four wings. The hind pair folds like a fan and is usually much larger than the front pair. Stoneflies have chewing mouthparts, but many of the adults do not feed. Metamorphosis is incomplete, the life stages being the egg, naiad, and adult. The Plecoptera have long antennae and a pair of long appendages at the tip of the abdomen (the cerci).

The growing stage (naiad) lives under stones in rapidly running streams. The adults are usually found resting on plants, trees, or stones near streams.

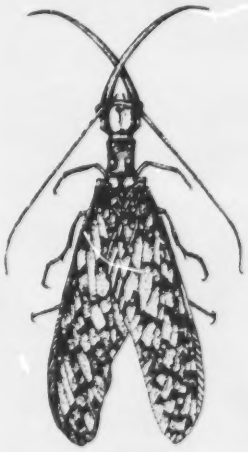
Stonefly
Family Perlidae

Megaloptera—The dobsonflies, fishflies and alderflies

About 15 species occur in Indiana.

The Megaloptera are medium to large-sized insects with long segmented antennae, four many-veined wings and chewing mouthparts. Metamorphosis is complete.

The dobsonfly adults are found near streams and are often attracted to lights. The larvae are called hellgrammites. They live under stones in rapid running streams and are prized by fishermen because they make excellent bait. Fishfly and alderfly larvae are also found in water but only reach about half the size of the hellgrammite which may attain a length of 3 inches.



Dobsonfly
Family Corydalidae

Neuroptera—The lacewings, mantispids, owlflies, and antlions

About 65 species occur in Indiana.

The Neuroptera are medium-sized insects that have four many-veined wings. The adults have chewing mouthparts and their antennae are usually long. Metamorphosis is complete, the life stages being the egg, larva, pupa, and adult. The lacewings, also called aphidlions, are found on trees and other plants wherever aphids occur. The antlion larvae are the familiar "doodlebugs," which live in the ground and dig pitfalls in which they trap ants and other insects. The adults resemble damselflies but have readily visible antennae.

Lacewing
Family Chrysopidae

Antlion
Family Myrmeleontidae

Coleoptera—The beetles

About 5,000 species occur in Indiana.

Nearly all beetles have four wings, the upper pair being hard and shell-like. Metamorphosis is complete, the life stages being the egg, larvae, pupa, and adult. Both the larvae and adults have chewing mouthparts. The larvae of beetles are often called grubs.

Beetles are found almost everywhere. For example, whirligig beetles and diving beetles live in water, whereas cucumber beetles, the Mexican bean beetle and alfalfa weevil feed on vegetation. The plum curculio attacks fruits; the granary weevil feeds in stored grains; and stag beetles live in stumps and decaying logs. Others, such as scavenger beetles, live on dead animals. Some Coleoptera, like lady beetles and ground beetles, are beneficial because they feed on injurious insects.

The stylopids are very unusual beetles that are parasitic on other insects such as wasps. They have been considered by some entomologists as a separate order called Strepsiptera.

(Coleoptera continued)

Japanese beetle
Family Scarabaeidae

Rhinocerus beetle
Family Scarabaeidae

Longhorn beetle
Family Cerambycidae

Tortoise beetle
Family Chrysomelidae

Flea beetle
Family Chrysomelidae

Colorado potato beetle
Family Chrysomelidae

Clover leaf weevil
Family Curculionidae

Alfalfa weevil
Family Curculionidae

Elm leaf beetle
Family Chrysomelidae

Body of Wasp

Stylopid

Stylopid
Family Stylopidae

Spotted cucumber beetle
Family Chrysomelidae

Snout beetle
Family Curculionidae

Saw-toothed grain beetle
Family Silvanidae

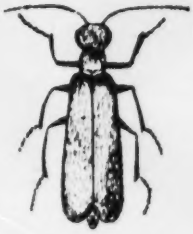
Click beetle
Family Elateridae

Metallic wood borer
Family Buprestidae

Lady beetle
Family Coccinellidae

Flour beetle
Family Tenebrionidae

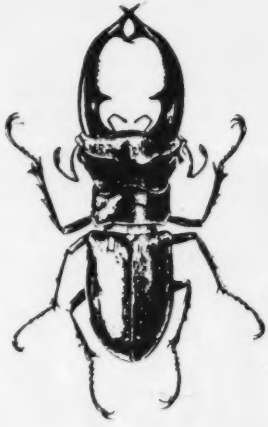
Mexican bean beetle
Family Coccinellidae



Blister beetle
Family Meloidae

Dung beetle
Family Scarabaeidae

Spider beetle
Family Ptinidae



Stag beetle
Family Lucanidae

June beetle
Family Scarabaeidae

Rose chafer
Family Scarabaeidae

(Coleoptera continued)

Tiger beetle
Family Cicindelidae

Ground beetle
Family Carabidae

Carrion beetle
Family Silphidae

Whirligig beetle
Family Gyrinidae

Rove beetle
Family Staphylinidae

Soldier beetle
Family Cantharidae

Firefly
Family Lampyridae

Net-winged beetle
Family Lycidae

Larder beetle
Family Dermestidae

Cadelle
Family Ostomatidae

Mecoptera—The scorpionflies

About 20 species occur in Indiana.

The scorpionflies are small to medium-sized insects with four long, narrow wings and long antennae. They have chewing mouthparts located at the end of a broad, flat snout, which is two or three times as long as the head is wide. Metamorphosis is complete, the life stages being the egg, larva, pupa, and adult. Scorpionflies are harmless, but they are so named because some of the males have the end of the abdomen enlarged so it looks like the stinger of a scorpion.

These insects are found resting on plants that grow along the banks of streams and in damp woods. The larvae are caterpillar-like and live in damp soil. The adults feed on insects, usually after they are dead, although certain species do capture live insects. The adults are sometimes attracted to lights.

Scorpionfly
Family Panorpidae

Trichoptera—The caddisflies

About 150 species occur in Indiana.

The caddisflies are medium-sized, four-winged, moth-like insects having long, slender antennae. They have chewing mouthparts, but the adults probably do not feed. Metamorphosis is complete, the life stages being the egg, larva, pupa, and adult.

The larvae of caddisflies live in streams and ponds and cover their bodies with portable cases made of small stones and other materials webbed together with silk. This case-making habit gives the order its common name, since the word caddis means "case." The adults are found near the streams, ponds, or lakes in which the larvae live. Caddisflies are attracted to lights in large numbers.

Caddisfly
Family Hydropsychidae

Lepidoptera—The butterflies and moths

About 2,500 species occur in Indiana.

Butterflies and moths have four wings and siphoning mouthparts (mouthparts prolonged into a long, tongue-like organ). A few of the adults, such as female cankerworms, are wingless. Metamorphosis is complete, the life stages being the egg, larva, pupa, and adult. The larvae of butterflies and moths are called caterpillars and have chewing mouthparts. The pupa of most moths is enclosed in a cocoon.

Moths hide during the daytime and are active at night, while butterflies fly during the day and are inactive at night. Butterflies are usually brighter colored than moths, hold their wings upright when at rest, and have their antennae enlarged or knob-like at the tip. One group of butterflies, the skippers, have the tips of their antennae bent back like the handles of canes. Moths are dull colored, fold their wings flat on the back or extend them sideways when at rest, and never have antennae with knobs at the tips. Butterflies visit flowers during the day. Many moths come to lights at night and many of the larvae are injurious to plants.

Black swallowtail butterfly
Family Papilionidae

Cabbage butterfly
Family Pieridae

Cankerworm moth
(female)
Family Geometridae

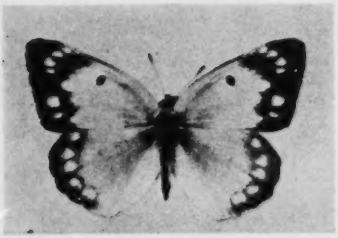
Grass moth
Family Crambidae

Carpenterworm moth
Family Cossidae

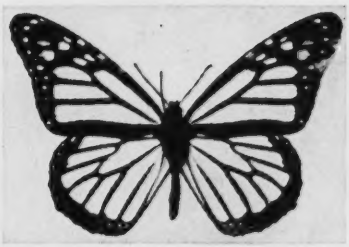
Clothes moth
Family Tineidae

Corn borer moth
Family Pyraustidae

Angoumois grain moth
Family Gelechiidae

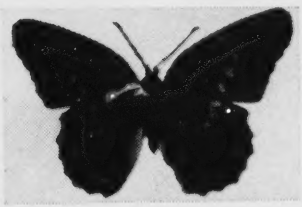


Alfalfa butterfly
Family Pieridae



Monarch butterfly
Family Danaidae

Wood nymph butterfly
Family Satyridae



Fritillary butterfly
Family Nymphalidae

Red admiral butterfly
Family Nymphalidae

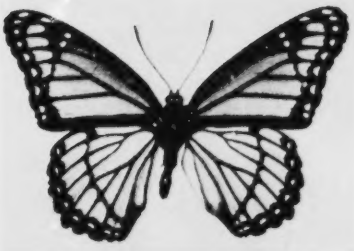
Painted lady butterfly
Family Nymphalidae

Mourningcloak butterfly
Family Nymphalidae

Goatweed butterfly
Family Nymphalidae

(Lepidoptera illustrations continued)

Buckeye butterfly
Family Nymphalidae



Viceroy butterfly
Family Nymphalidae

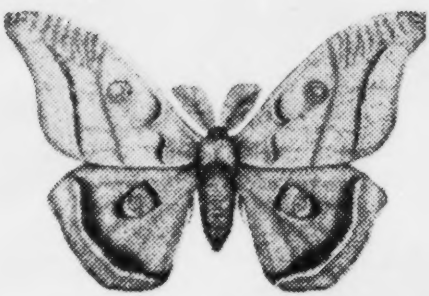
Tailed blue butterfly
Family Lycaenidae

Silver-spotted skipper
Family Hesperiidae

Clear-winged sphinx moth
Family Sphingidae

White-lined sphinx moth
Family Sphingidae

Tomato hornworm moth
Family Sphingidae



Polyphemus moth
Family Saturniidae

Io moth
Family Saturniidae

Cecropia moth
Family Saturniidae

Tiger moth
Family Arctiidae

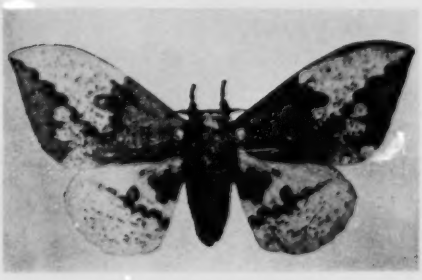
Salt-marsh caterpillar moth
Family Arctiidae

Luna moth
Family Saturniidae

Underwing moth
Family Noctuidae

Cutworm moth
Family Noctuidae

Regal moth
Family Citheroniidae



Imperial moth
Family Citheroniidae

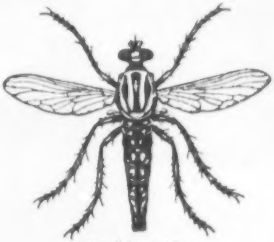
39
EL 20

Diptera—The flies

About 3,600 species occur in Indiana.

Flies differ from other insects by having only two true wings. The hind pair is reduced to small, club-like organs called halteres. A few flies, such as the sheep ked, are wingless. Many flies, including mosquitoes and horse flies, have piercing-sucking mouthparts. The house fly, however, possesses another type known as sponging mouthparts, which it uses to sponge up liquid food. Metamorphosis is complete, the life stages being the egg, larva, pupa, and adult. The larvae are generally called maggots, and the pupal cases are called puparia.

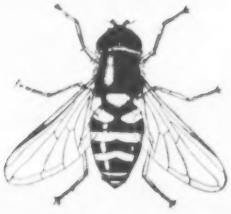
Flies are found around flowers, decaying vegetation, on animals and in houses and barns.



Robber fly
Family Asilidae

Crane fly
Family Tipulidae

Horse fly
Family Tabanidae

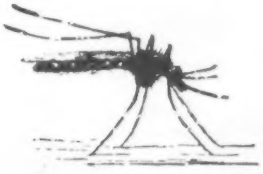


Syrphid fly
Family Syrphidae

Sheep ked
Family Hippoboscidae

Drosophila fly
Family Drosophilidae

House fly
Family Muscidae



Mosquito
Family Culicidae

Bee fly
Family Bombyliidae

Siphonaptera—The fleas

About 28 species occur in Indiana.

The fleas are small, wingless insects that live as parasites on the bodies of animals. Adult fleas have piercing-sucking mouthparts and the larvae chewing mouthparts. Their metamorphosis is complete, the life stages being the egg, larva, pupa, and adult. The larvae resemble small maggots and live in the soil or near the bedding of their hosts.

The best way to collect fleas is to dust pyrethrum powder on a dog or cat and hold the animal over a white cloth or paper. The fleas will drop off and can be picked up.

Flea
Family Pulicidae

Hymenoptera—The bees, wasps, ants, sawflies, and hymenopterous parasites

About 2,800 species occur in Indiana.

The Hymenoptera usually have four wings but some, such as worker ants, are wingless. If wings are present, they have few cross veins, and the hind pair is usually shorter than the front pair. Most Hymenoptera have chewing mouthparts, but in the bees and wasps, the lower lip is prolonged into a tongue. All Hymenoptera except the sawflies have the abdomen constricted or "pinched in" where it joins the thorax. Metamorphosis is complete, the life stages being the egg, larva, pupa, and adult.

Most adult Hymenoptera frequent flowers. The larvae of ants, bees and wasps are found in the nest, but those of sawflies feed on plants.

Sawfly
Family Tenthredinidae

Horntail
Family Siricidae

Ichneumon wasp
Family Ichneumonidae

Honey bee
Family Apidae

Bumble bee
Family Apidae

(Hymenoptera illustrations continued)

Velvet ant
Family Mutillidae

Ant
Family Formicidae

Hornet
Family Vespidae

Yellow jacket
Family Vespidae

Mud dauber wasp
Family Sphecidae

Cicada killer wasp
Family Sphecidae

WHERE TO GET SUPPLIES

Insect pins, killing jars, nets and other supplies needed for collecting and preserving insects can be obtained from any one of several concerns. Below are the names and addresses of a few such companies

Indiana Farm Bureau Cooperative, Inc.
47 South Pennsylvania Street
Indianapolis, Indiana 46204

Carolina Biological Supply Co.
Burlington, NC 27215

Entomological Supplies
P.O. Box 4748
Baltimore, MD 21211

General Biological Supply House
8200 South Hoyne Avenue
Chicago, Illinois 60620

Ward's Natural Science Establishment, Inc.
3000 Ridge Road East
Rochester, New York 14622

CONTROLLING DESTRUCTIVE INSECTS

Publications on controlling destructive insects can be obtained from any County Extension Office or by writing to Agricultural Publications, Agricultural Administration Building, Purdue University, West Lafayette, Indiana 47907.

REFERENCE BOOKS

Borror, D. J. and R. E. White, *A Field Guide to the Insects of America North of Mexico,* 404 pp. Boston, Houghton Mifflin Co.

Fichter, G. S. and H. S. Zim, *Insect Pests,* 160 pp. New York, Golden Press.

Jacques, H. E., *How to Know Insects,* 205 pp. Dubuque, Iowa, William C. Brown Co.

Borror, D. J. and D. M. DeLong, *An Introduction to the Study of Insects,* 1030 pp. New York, Rinehart and Co.

Zim, H. S. and C. Cottam, *Insects,* 160 pp. New York, Golden Press.

Mitchell, R. T. and H. S. Zim, *Butterflies and Moths,* 160 pp. New York, Golden Press.

HOW TO IDENTIFY INSECTS

It is only natural for every insect collector to want to classify and know the name of each specimen he finds. He should not become discouraged, however, if he is unable to do this, because there are more different kinds of insects in the world than all other animals combined. In fact, about 75 percent of all living animals are insects, and entomologists estimate that there are at least 16,000 different species in Indiana alone.

Examples of most of the insects in this state have been collected at one time or another, classified by entomologists and each given a scientific name, such as *Acalymma vittata.*

The average person seldom uses these scientific names, but refers to insects by common name, such as "black blister beetle," "blister beetle" or even by "beetle" alone. In this case, black blister beetle is the common name for *Epicauta pennsylvanica,* a specific kind or species of insect; blister beetle, on the other hand, is a common name for all members of the family Meloidae; whereas the term beetle refers to thousands of different insects belonging to the order Coleoptera. Even though common names are very important, you can see that not all of them refer to individual insects. To complicate the matter further, common names vary widely from one locality to another. For these reasons, scientific names are necessary, especially to the entomologist.

Amateur collectors can gain the best knowledge of insects by first being able to classify them according to their order name. An order name is simply the name applied to a large group of insects having similar characteristics. For example, all butterflies and moths belong to the order Lepidoptera; all beetles, regardless of size, shape or color, belong to the order Coleoptera; and all flies to the order Diptera.

For those who have sufficient interest, the orders of insects may, in turn, be broken down into families, the families into genera and the genera into species. The first word of a scientific name is the genus to which the specimen belongs, and the second word is the species name.

The key will assist you in classifying your specimens to the order level.

A PICTORIAL KEY TO THE ORDERS OF ADULT INSECTS

winged

wingless
(see key page VI)

front wings hardened, leathery or parchmentlike at least at the base

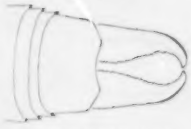
front wings membranous
(see key page II)

chewing mouthparts

sucking mouthparts

without pincer-like cerci

with pincer-like cerci



DERMAPTERA
(earwigs)

front wings leathery at base and membranous at end

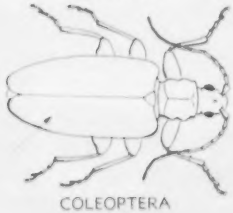
HEMIPTERA
(true bugs)

front wings of uniform texture

HOMOPTERA
(leafhoppers, planthoppers, cicadas, spittlebugs)

front wings with branched veins

front wings hard, without veins; may be lined



COLEOPTERA
(beetles)

jumping insects; hind femur enlarged; tarsi with four or fewer segments

walking insects; hind femur not enlarged; tarsi with five segments

ORTHOPTERA
(crickets, katydids, grasshoppers)

DICTYOPTERA
(roaches, mantids, walkingsticks)

II

continued from key page I

two wings

four wings

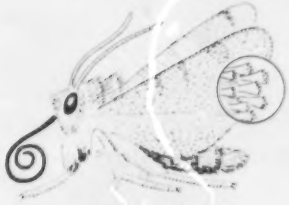
pronotum extended over abdomen

pronotum not extended over abdomen

wings with few or no scales, without coiled proboscis

wings usually covered with scales, mouthparts consist of coiled proboscis

ORTHOPTERA
(pigmy grasshoppers)



LEPIDOPTERA
(butterflies and moths)

very slender wing with fringe of hairs as long as wing is wide

fringe of hairs, or if present, not as long as wing is wide

THYSANOPTERA
(thrips)

(see key page III)

end of abdomen without noticeable appendages

end of abdomen with style or thread-like tail

with haltere-like organs in front of wings

with halteres behind wings

style-like tail

two or three thread-like tails

COLEOPTERA
(male stylopids)

DIPTERA
(flies, mosquitoes, gnats, midges)

HOMOPTERA
(male scales)

EPHEMEROPTERA
(mayflies)

III

continued from key page II

hind wings equal to or larger than front wings (see key page IV)

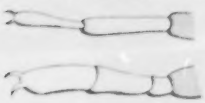
hind wings smaller than front wings

no long abdominal appendages

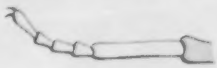
abdomen with two or three thread-like tails

EPHEMEROPTERA (mayflies)

tarsi two or three segmented



tarsi with more than three segments (usually five)



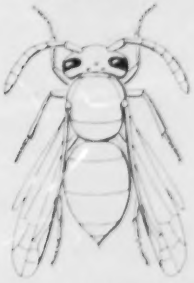
piercing-sucking mouthparts

chewing mouthparts

HOMOPTERA (cicadas, leafhoppers, planthoppers, spittlebugs)

antennae as long as body; wings and body often with scales

antennae shorter than body; no noticeable scales



HYMENOPTERA (bees, wasps, ichneumons)

TRICHOPTERA (caddisflies)

cerci present

ZORAPTERA (zorapterans)

cerci absent

PSOCOPTERA (barklice, booklice)

IV

continued from key page III

mouthparts close to eye

mouthparts at end of beak-like structure some distance from eye

MECOPTERA
(scorpionflies)

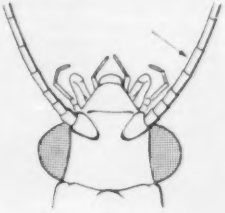
wings never held flat over abdomen

wings held flat over abdomen

bristle-like inconspicuous antennae

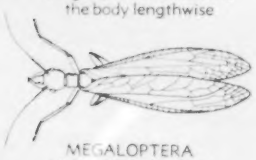
ODONATA
(dragonflies, damselflies)

antennae apparently with several segments



(see key page V)

hind wings with enlarged anal area folded fan-like; wings tend to curl around the body lengthwise



MEGALOPTERA
(dobsonflies, fishflies, alderflies)

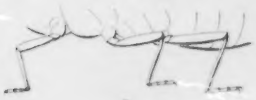
hind wings without enlarged, folded anal area; wings do not tend to curl around body lengthwise

NEUROPTERA
(lacewings, mantispids, owlflies, antlions)

V

continued from key page IV

all legs of walking type



hind legs modified for jumping

ORTHOPTERA
(tree crickets)

basal segment of front tarsus has swollen appearance

EMBIOPTERA
(webspinners)

basal segment of front tarsus about same size as ones immediately following

cerci usually long; more than eight segments

PLECOPTERA
(stoneflies)

cerci short; with two to eight segments

ISOPTERA
(termites)

VI

continued from key page I

antennae present

antennae absent

legs present

legs absent

fewer than twelve abdominal segments

twelve abdominal segments

head and thorax separate

head and thorax fused

DIPTERA
(louse flies, bat flies)

PROTURA
(proturans)

HOMOPTERA
(scales)

COLEOPTERA
(female stylopids)

collophore present; spring-like organ usually present

both collophore and spring-like organ absent

COLLEMBOLA
(springtails)

long tail-like appendages absent

two or three tail-like appendages present

two tail-like appendages

three tail-like appendages

body not flattened

body flattened laterally or dorsoventrally

(see key page VIII)

(see key page VII)

DIPLURA
(campodeids)

THYSANURA
(silverfish)

VII

continued from key page VI

body flattened dorsoventrally

body flattened laterally

SIPHONAPTERA
(fleas)

sucking mouthparts externally visible

no sucking mouthparts externally visible

antennae longer than head

antennae shorter than head

HEMIPTERA
(true bugs)

DIPTERA
(louse flies and bat flies)

antennae longer than head

antennae shorter than head

basal segment of front tarsus not swollen

basal segment of front tarsus swollen

EMBIOPTERA
(webspinners)

tiny insects; tarsi two or three segmented

large insects; tarsi five segmented

PSOCOPTERA
(booklice, barklice)

DICTYOPTERA
(roaches, mantids, walkingsticks)

head wider than thorax at point of attachment to thorax

head narrower than thorax at point of attachment to thorax

MALLOPHAGA
(biting lice)

ANOPLURA
(sucking lice)

VIII

continued from key page VI

abdomen and thorax broadly joined together

abdomen and thorax narrowly joined together

HYMENOPTERA
(ants)

body covered with scales

LEPIDOPTERA
(female cankerworm)

body not covered with scales

tarsal claws absent

THYSANOPTERA
(thrips)

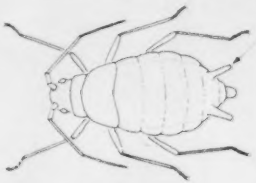
tarsal claws present

piercing-sucking mouthparts

chewing mouthparts

cornicles absent

cornicles usually present



HOMOPTERA
(aphids)

with distinct head and eyes

HEMIPTERA
(bed bugs)

without distinct head and eyes

HOMOPTERA
(female scales)

abdominal forceps present

abdominal forceps absent
(see key page IX)

entire body rather hard and brown colored

DERMAPTERA
(earwigs)

body soft and whitish except forceps which are hardened and brown

DIPLURA
(japygids)

IX

continued from key page VIII

mouthparts at end of beak-like structure some distance from eye

MECOPTERA
(scorpionflies)

mouthparts not elongate, close to eyes

cerci present

cerci absent

antennae longer than one-third of body length

PSOCOPTERA
(barklice and booklice)

antennae shorter than one-fourth of body length

COLEOPTERA
(female stylopids)

body leathery and usually grey or dark colored

ORTHOPTERA
(crickets)

body soft and pale colored

two tarsal segments

ZORAPTERA
(zorapterans)

three to five tarsal segments

basal segment of front tarsi with swollen appearance

EMBIOPTERA
(webspinners)

basal segment of front tarsi about same size as ones immediately following

ISOPTERA
(termites)